MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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WARREN DE LA RUE, Vice-President, in the Chair.

J. M. Eustace, Esq., Wimbledon;
J. E. H. Peyton, Esq., 63 Chester Square;
W. Garnett, Esq., Bashall Lodge, Clitheroe;
Capt. J. Williams, Aberdeen; and
Lieut. H. F. Yeatman, R.N., Sherborne, Dorset,

were balloted for and duly elected Fellows of the Society.

On the Eye-piece for Correction of Atmospheric Dispersion.

By G. B. Airy, Astronomer Royal.

In a late Number of the *Monthly Notices*, I showed that the effect of atmospheric dispersion on the images of celestial objects viewed at small elevations (to which I may add, the chromatic separation produced by slight error in the centering of the lenses of an object-glass), might be corrected by the insertion of a prism of proper angle in the eye-piece. It was obviously an inconvenience, though a very trifling one, that a battery of different prisms must be prepared for different elevations of the object viewed; and it would be better, if possible, to avoid the insertion of an additional piece of glass.

Mr. William Simms pointed out to me that a prism of adjustible angle would be produced by causing the convexity of a plano-convex lens to roll in the concavity of a plano-concave lens,

the radii of curvature of the convex and concave surfaces being equal. This construction would relieve the first of the inconveniences which I have mentioned, but would aggravate the second.

After various suggestions, Mr. W. Simms and myself arrived, independently and simultaneously, at a construction which, for simplicity and optical perfection, is not likely to be improved. It consists merely in making the eye-glass (supposed to be plano-convex) broader than is strictly necessary for the telescopic vision, causing it to press by its convex surface into a concave cup at the eye-end of the eye-piece, and allowing it to roll in that concavity; thus presenting different parts of its convex surface, though always in the same form and position, to the rays of light which come from the field-glass, but presenting to the eye a plane

Fig 1.

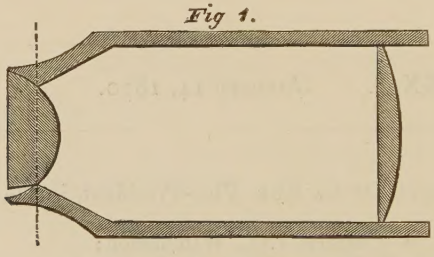
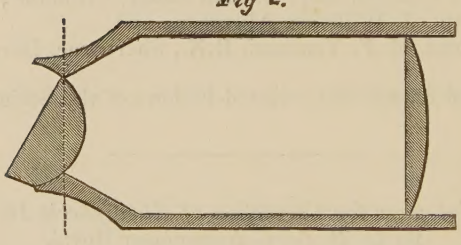


Fig 2.



surface, which, in one position of the lens, is normal to the telescope-axis, and, in another position of the lens, is inclined to it.

The above diagrams will explain the optical action of such an eye-piece.

Fig. 1 shows the position of the lens in the state for ordinary use.

Fig. 2 shows its position when atmospheric dispersion, &c., are to be corrected.

It will be seen that, in each case, the dotted line separates, on the telescope-side, a plano-convex lens of definite form; but that, in the first case, there is applied to it on the eye-side a piece of glass bounded by two parallel surfaces; and in the second

case, there is applied to it a prism, whose angle is gradually varied by gradually varying the position of the lens in its cup.

I have represented the large eye-lens as incomplete towards the lower edge. Optically, no injury is produced by making it complete; but I thought it possible that the projection of the lens edge might be inconvenient to the observer's eye; and also that the bluff termination of the lens might be convenient for the application of screw-motion.

The eye-piece in this state presents these advantages: it introduces no additional glass; it allows the use of a prism with angle gradually changing; and it does not disturb the corrections for spherical aberration.

It seems not too much to say that every telescope intended for delicate purposes might advantageously be furnished with such an eye-piece.

The eye-piece must have a swivel or rotatory motion round the axis of the telescope. A very simple screw arrangement, in a specimen eye-piece furnished to me by Mr. Simms, appears to place the eye-glass entirely under command.

1869, *Dec.* 20.

Seventh Catalogue of Double Stars, observed at Slough, in the years 1823–1828 *inclusive, with the* 20*-feet reflector; 84 of which have not been previously described.* By Sir J. F. W. Herschel, Bt. F.R.A.S. (Abstract.)

The observations of double stars herewith submitted to the Royal Astronomical Society were made in the course of my earlier sweeps at Slough, with the 20-feet reflector, and would have been included in the third of those Catalogues of double and triple stars observed with that instrument which the Society has already honoured with a place in its Transactions, but for a two-fold reason, viz., that that Catalogue was limited, 1st, to stars not before (to my knowledge) observed as double; and 2ndly, to the completion of a first exact thousand of such objects; thus causing the exclusion of 84, which are here entered as Nos. 5450–5533, and which in the subsequent redaction of Catalogues 4, 5, and 6, would appear to have escaped entry, owing to non-advertence to this circumstance. The remainder of the present list is made up, for the most part, of stars included in Struve's Dorpat Catalogue, and recognised as such. Although the angles of position of these latter stars are given only from careful estimation, they are not without some considerable historical value, inasmuch as in a great many instances they are antecedent in point of date to any recorded measurements, and in several are the only existing records of position; and though in some particular cases widely erroneous, they yet present for the most part such an agreement with subsequent micrometrical measures as in the earlier stages of this branch of astronomy would have ren-

dered their evidence available in deciding on the probability or improbability of a binary connexion between the individuals. Having included them, moreover, among the data which I have been for a long time occupied in collecting and arranging in a general Synoptic History of these objects; a reference to some recorded collective statement of them accessible without recourse to the original sweeps became unavoidable.

Summary of Sun-spot Observations made by the Kew Photo-Heliograph during the year 1869.

(Communicated by Messrs. De La Rue, Stewart, and Loewy.)

The following table exhibits our annual *resumé* of Sun-observations made at the Kew Observatory, drawn up according to the plan of Hofrath Schwabe, in Dessau:—

Months.	Days of Observation.	Days without Sun-Spots.	Number of New Groups.	Nos. given to the New Groups in the Kew Catalogue of Sun-Spots.
January	14	0	15	No. 902 to 916
February	15	0	17	917 933
March	11	0	14	934 947
April	20	0	15	948 962
May	16	0	18	963 980
June	18	0	27	981 1007
July	22	0	18	1008 1025
August	19	0	25	1026 1050
September	21	0	21	1051 1071
October	18	0	17	1072 1088
November	11	0	15	1089 1103
December	11	0	22	1104 1125
Total	196	0	224	No. 902 1125

Remarks.—The steady increase in the number of groups and the immense areas which many of them covered, points to the approaching maximum of the sun-spot period.

The year was also characterised by a remarkable tendency of the groups to appear in successive trains, within narrow and well-defined zones on both sides of the solar equator. Such a regular successive appearance of spots along parallels of latitude had previously been observed, but it usually only lasted during a short period, after the lapse of which the distribution in latitude became again irregular. Last year the irregularity of distribution was rather the exception. It is not improbable that a distinct law may be traced at some future time in this singular behaviour, and we recommend the subject to the attention of observers.

Kew Observatory, January 1, 1870.

On the Determination of the Orbit of a Planet from Three Observations. By Prof. Cayley. (Abstract.)

The author has proposed to himself to consider from a geometrical point of view the problem of the determination of the Orbit of a Planet from Three Observations. The Orbit is a conic, having the Sun for a focus, and each observation shows that the Planet is at the date thereof in a given line; we have thus a given point or focus, S, and three given lines, say the "rays." The orbit-plane, if known, would, by its intersections with the three rays, determine the three positions of the planet: that is, we should have the focus and three points on the orbit, or, what is the same thing, three radius-vectors from the focus, say a "trivector": geometrically, through three given points and with a given focus, there may be described four conics, but (as explained in the Memoir) only one of these can be the orbit; the orbit is thus determined, and that uniquely, by means of a given trivector. The problem therefore is to find the orbit-plane such that in the orbit determined by means of the trivector the times of passage between the three positions on the orbit may have the observed values, or (what is the same thing) that the orbital areas, each divided by the square root of the *latus rectum*, may have given values. Instead of the orbit-plane, the author considers the orbit-axis (that is, the line normal to the orbit-plane at the point S), or rather the intersection of this line with a sphere about the centre S, say the orbit-pole. To a given position of the orbit-pole there corresponds as above a determinate orbit, and the problem is to find the position of the orbit-pole such that in the orbit belonging thereto the times of passage may have given values, as already mentioned. The required position of the orbit-pole may be obtained as the intersection of two spherical curves, one of them the locus of the orbit-pole when the time of passage between the first and second points on the orbit has its proper given value, the other the locus where the time of passage between the second and third points has its proper given value; and in connexion herewith other isoparametric loci present themselves, for instance, the iseccentric lines, or loci of the orbit-pole such that along each of them the excentricity of the orbit has a given value. The object which the author has proposed to himself in the Memoir is the discussion of the configuration &c. of these loci. He considers, in the first instance, any three given rays whatever, but in the ulterior discussion of the spherical curves, which is carried out numerically, he has confined himself to the case of a particular symmetrical position of the three rays; viz., these are taken to be lines each at an inclination of 60° to a fixed plane through S; and such that their projections on this plane form an equilateral triangle having S for its centre, and that each ray cuts the plane in the mid-point of the corresponding side of the triangle. The results are exhibited graphically by means of the figures called spherograms, each the representation (on the stereographic projection) of the

half-surface of a sphere (not a hemisphere in the ordinary sense of the word, for there is great advantage in employing a different form of boundary)—viz., there is an *e*-spherogram, showing the iseccentric lines; and a T-spherogram showing the isochronic lines.

On the application of Photography as a means of determining the Solar Parallax from the Transit of Venus in 1874. By Richard A. Proctor, B.A.

It is impossible to read Mr. De La Rue's account of the results of careful measurement applied to photographs of the solar eclipses in 1860 and 1868 without recognising that we have in photography, as applied to the approaching Transit of *Venus*, one of the most powerful available means of determining the Sun's distance. Within the last few years, solar photography has made a progress which is very promising in regard to the future achievements of the science as an aid to exact astronomy. So that doubtless, in 1874, astronomers will apply photographic methods to the transit of that year, with even greater success than we should now be prepared to anticipate. It has therefore seemed to me that the photographic observation of the coming transit merits at least as full a preliminary inquiry as either Halley's or Delisle's method of direct observation.

The result of an inquiry directed to this end has led me to the conclusion that photographers of the approaching transit should adopt for their guidance considerations somewhat different than those which have hitherto been chiefly attended to.

It is undoubtedly true, as Mr. De La Rue has pointed out, that the photographer of the transit can readily take a large number of pictures, and by combining these, can ascertain with great accuracy the path of *Venus* across the solar disc. And by comparing the paths thus deduced for different stations a satisfactory estimate can be formed of the solar parallax. I do not wish to suggest any departure from this course of procedure.

On the other hand, it is undoubtedly true, as Major Tennant has remarked, that the greatest effect of parallax will be obtained for any two stations, when both stations, the Earth's centre, and the centre of *Venus*, are in one and the same plane. So far as those two stations are concerned, his remark is just, that it is the position of *Venus* at the instant when the stations are so situated, and not the nearest approach of *Venus* to the Sun's centre, which should be compared. And further, Mr. De La Rue's comment on this, to the effect that his method in reality includes Major Tennant's, is also correct. In fact, there can be no doubt that the position of *Venus* at the particular instant referred to by Major Tennant can be far more exactly ascertained by a reference to the complete path of *Venus* for each station than from any attempt to secure nearly simultaneous photographic records at stations far removed from each other.

But it appears to me that the method I am about to suggest, according to which the whole question will be reduced to the determination of a parallactic displacement of *Venus* on a line through the centre of the Sun's disc, is the one by which the fullest assistance will be obtained from photography; while a source of error, which has not hitherto been specially considered, will be practically eliminated.

It must be remembered that in the comparison of photographic records, whether for the determination of the path of *Venus* across the Sun's disc at a particular station, or for the comparison either of *Venus's* apparent position or of her path as seen from two different stations, the accuracy of the results will depend in part on the certainty with which two or more pictures may be brought into comparison by means of a fiducial line or set of lines. It seems certain that no method can be devised by which all chance of error from this source can be eliminated. The great point would, therefore, seem to be to render its effect as small as possible.

Now let us consider for a moment Major Tennant's proposition, as giving a convenient illustration of the effects of any error either in the position of the fiducial lines, or in bringing those belonging to two pictures into exact correspondence. Let Fig. 1 represent the result of a comparison between two photographs of the Sun. A B and C D are fiducial cross-lines common to both pictures, *a* is the centre of *Venus* for one picture, *b* is her centre for the other; and on the exact measurement of *a b* depends the determination of the Sun's parallax, so far at least as these two pictures are concerned. Now it is very obvious that if the lines A B, C D for one picture, have not been brought into perfect correspondence with those belonging to the other, the distance *a b* will be correspondingly affected. In fact, it would appear that if the usual methods for making the correspondence as exact as possible are followed, almost as large an error would be introduced through this cause alone as by errors in the measurement of *a b*, since the two processes—the measurement of *a b* and the adjustment of the sets of cross-lines—depend on the very same circumstance, the nicety, namely, with which the eye and the judgment can estimate minute quantities of about the same relative dimensions.

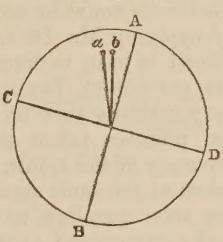


Fig. 1.

But now, if *a* and *b*, in place of having the position shown in Fig. 1, were situated as in Fig. 2, it is clear that the distance *a b* will not be appreciably affected by any small error in the adjustment of the fiducial lines.

The object, therefore, which it seems most desirable to secure is that *Venus*, as seen from two different stations at a particular instant, should have a relative parallactic displacement towards

the Sun's centre, or as nearly towards the Sun's centre as possible. This amounts to adding to Major Tennant's conditions this further one that the Sun's centre should be in the same plane with the two stations,—or rather to making this condition a substitute for that one which requires that the Earth's centre should be in the same plane with the two stations. For as a rule we must not expect to be able to secure that two convenient stations on the Earth, as well as the centres of the Earth, *Venus*, and the Sun, should be in the same plane.

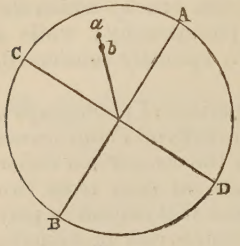


Fig. 2.

Mr. De La Rue's remark that by taking a series of pictures the position of *Venus* may be ascertained at any moment is in reality quite as applicable to my suggestion as to Major Tennant's. In fact, were it not, we might despair of securing the desired object, since we have no reason for believing that astronomers are so certain as to the exact progress of the transit, that the conditions could be secured by anticipatory instructions: whereas by applying Mr. De La Rue's method it will be possible after the transit is past, to determine with any desired degree of accuracy the position of *Venus* at the proper instant. And further, it is very obvious that no error in the placing of the fiducial lines for pictures taken at the same stations can much affect the accuracy of the result, since the comparison of successive pictures, taken at the same station, does not directly involve the element of the solar parallax, as when we have to compare two pictures or paths determined at different stations.

The object, then, of the present paper and the accompanying chart is to determine what stations are most suitable for applying photography to the transit of 1874, on the principles above enumerated. I think the drawing will be found, however, to be also an instructive illustration of the whole character of the transit.

In a paper in the *Monthly Notices* for March last, I showed how all the chief elements of the transit could be deduced by con-

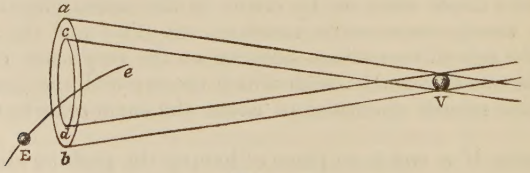


Fig. 3.

sidering the motion of *Venus* relatively to a pair of cones, each enveloping the Sun and the Earth, but one having its vertex outside the Earth, the other having its vertex between the Earth and the Sun. For my present purpose it will be convenient to con-

sider the motion of the Earth relatively to a pair of cones similarly enveloping the Sun and *Venus*.

Fig. 3 represents a portion of these cones around *Venus* at V. E *e* is the Earth's orbit relatively to these cones; *a b* is the circular section of the outer cone, *c d* that of the inner. *Venus* is supposed to be approaching the eye, and therefore the Earth also would, at the time of conjunction, be approaching; but as we are considering the Earth's motion relatively to the two cones, and as *Venus* moves more rapidly in her orbit than the Earth, we must suppose the Earth to traverse the sections *a b* and *c d* in direction E *e*. When the circumstances of the transit of 1874 are attended to, it results that the motion of the Earth relatively to the sections *a b* and *c d* is as shown in Fig. 4. The various circles represented along the parallels E *e* correspond to the various positions of the Earth represented in the illustrative plate.

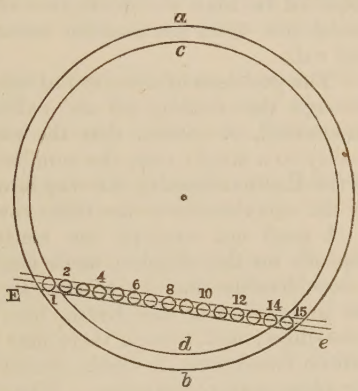


Fig. 4.

Comparing Figs. 3 and 4, it will be seen at once that as soon as the Earth reaches the outer circle *a b*, external contact begins. With the peculiarities of this phase, we need not concern ourselves. When the Earth reaches the circle *c d*, as at position 1, Fig. 4, internal contact begins, and when the Earth just touches the circle *c d* on the inside, the transit has begun for all places on the Earth's illuminated hemisphere. The positions 1 and 2 correspond to the cases of internal contact most accelerated and internal contact most retarded. They have been added to the illustrative plate for the sake of completeness, but in reality they do not belong to the special subject of this paper, since, as Mr. De La Rue has remarked, the photographer need not set himself to observe special phases of this sort. The same remark applies to the positions 14 and 15.

The remaining positions of the Earth in Fig. 4, corresponding to the 11 pictures 3–13 in the illustrative plate, are those occupied by the Earth at successive intervals of 15 minutes, the picture numbered 8 corresponding to the position occupied by the Earth at $16^h\ 6^m\ 31^s$ G.M.T., on Dec. 28th 1874, when *Venus* makes her nearest approach to the centre of the Sun's disc.

Now if we look at Figs. 3 and 4, and consider what they represent, we shall see that Fig. 4 may be looked upon as exhibiting an inverted picture of the Sun's disc and the transit of *Venus's* centre across it: we see, in fact, that the apparent position occupied at any instant by any point on the Earth's surface

in Fig. 4, corresponds exactly to the position occupied by *Venus* upon the Sun's disc, as supposed to be seen from that point of the Earth's surface at the instant in question. We have only to invert Fig. 4, and look at it from behind to see what sort of path *Venus* would seem to traverse upon the Sun's disc, either with reference to the Earth's centre, or to any point of the Earth's surface supposed to be properly depicted upon the small figures 1—15.

It follows, therefore, that if we want to determine two stations at which at any instant *Venus* would appear to have a relative parallactic displacement towards the Sun's centre, all that is required is that we select two stations which are on the same radial line from the common centre of the circular sections *a b* and *c d*.

The positions of those radial lines which cross the Earth's track through the section *c d* are exhibited in the plate. It will be understood, of course, that the three rows of figures belong in reality to a single row, the numbering of the successive pictures of the Earth indicating the way in which that row would be formed by the combination of the three rows shown in the plate.

I need not explain the construction of the plate, which depends on the simplest mathematical principles. I have taken a considerable amount of care to secure accuracy, not only in the projections of the Earth, but in the position of the radial cross-lines; and, though there may be minute inexactnesses, there will be found none, I think, which affect the purpose for which the plate was constructed. What that purpose is, will be best illustrated by simply examining the indications of the successive pictures.

Passing over pictures 1 and 2, we notice in Fig. 3, that Kerguelen's Land and Crozet Island, lying nearly on a line with certain of the Aleutian Islands, suggest that pictures taken at the former stations at the beginning of the transit could be advantageously compared with pictures simultaneously, or almost simultaneously, taken at a station on one of the easternmost of the Aleutians. In like manner pictures taken near Enderby Land could be advantageously compared with pictures taken at Woahoo. Projection 4 does not differ much from the preceding, but the cross-lines have assumed a less inclined position, and Kerguelen's Land could, at the epoch belonging to this picture, be better combined with a somewhat more westerly Aleutian island.

Projection 5 exhibits the advantage of a photographic station at or near Yokohama. Probably such a station, combined with one in Crozet Island or Kerguelen's Land, would give (by pictures taken near the hour belonging to Projection 5) absolutely the best results which photography can give.

The remaining projections suggest the following combinations of photographic records:—

Projection 6. Yokohama and Enderby Land, Kerguelen's Land

and a station in Manchooria; Crozet Island and Pekin; Cape of Good Hope and Nertchinsk.

Projection 7. Kerguelen's Land and Tsitsikar; Crozet Island and Nertchinsk; Cape Town and a station west of Lake Baikal.

Projection 8. Kerguelen's Land and Nertchinsk; Cape Town and Peshawur; Repulse Bay or neighbourhood and Yokohama; Perth (Australia) and Yokohama.

Projection 9. Repulse Bay and Yokohama; Enderby Land and Nertchinsk; Crozet Island and Calcutta; Cape Town and Bombay.

Projection 10. Repulse Bay and Nertchinsk; Possession Island (near South Victoria Land) and Yokohama; Kerguelen's Land and Calcutta; Crozet Island and Peshawur; Cape Town and Teheran.

Projection 11. Possession Island and Tsitsikar; Repulse Bay and neighbourhood of Lake Baikal; Enderby Land and Calcutta; Kerguelen's Land and Madras; Crozet Island and Peshawur; Cape Town and Aden.

Projection 12. Possession Island and Nertchinsk; Enderby Land and Madras; Kerguelen's Land and Peshawur; Crozet Island and Teheran.

Projection 13. Possession Island and neighbourhood of Lake Baikal; Repulse Bay and Calcutta; a New Zealand station and Yokohama; Hobart Town and a station near the mouth of the Amoor.

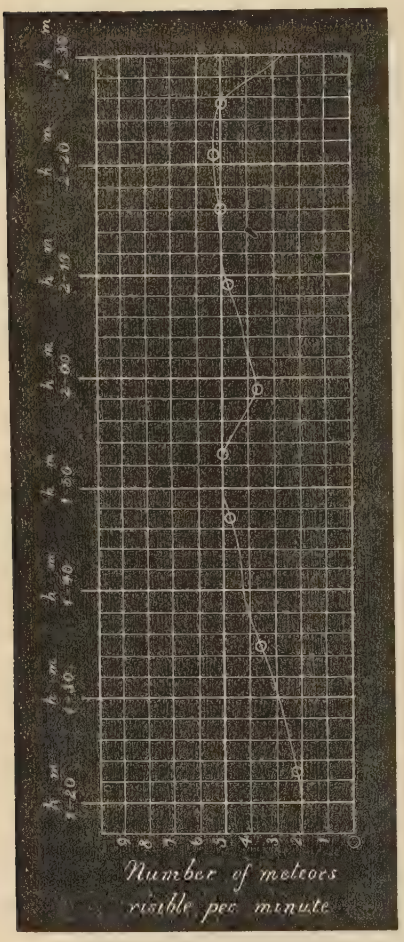
From this list we see that Kerguelen's Land and Crozet Island; Peshawur and other Indian stations; and stations in Siberia, are those which give the most favourable opportunities for the application of the photographic method.

Observations of Meteors, Nov. 13–14, 1869, *at Santa Barbara, California.* Observers, G. Davidson and Mrs. E. Davidson.

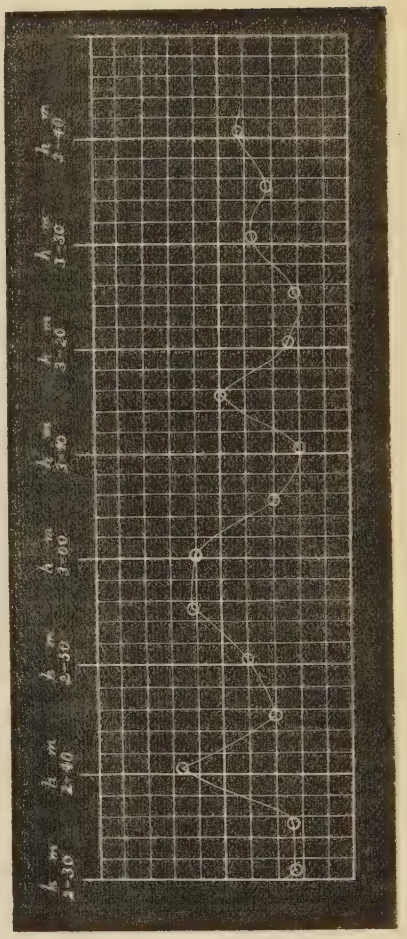
Watch was kept in camp for the meteoric shower; the night beautifully clear; Moon ten days old and 4° S. Decl. I was called at $1^h\ 10^m$, up to which time 22 meteors had been seen. The diagram exhibits the numbers noted by two observers up to $3^h\ 43^m$ A.M. After that time watch was kept up for any unusual display, but the numbers gradually diminished. The total number recorded was 556 in $2^h\ 25^m$. Some of the meteors were very brilliant and left persistent trains.

"At $1^h\ 25^m$ a meteor without apparent motion suddenly appeared, and burst in the same position. It was about 2° above and to the left of the bright star in the blade of the Sickle." (S. R. Throckmorton, Jun.)

At $2^h\ 33^m$ I observed a brilliant meteor start from a point above and a little to the left of the pointers; it left a persistent train and disappeared at a point about 9° or 10° above *Polaris*



From 2^h 22^m to 2^h 42^m, I was watching the persistent train of a meteor.
From 2^h 16^m to 2^h 55^m, Messrs. Throckmorton and Harford saw an average of 3 per minute.



and 6° to the right. The train was 5° in length; gradually it took a wavy form ; then curved until it formed $\frac{2}{3}$ of an irregular circle , and was 3° in diameter, and $\frac{1}{2}$ a degree in width. I examined it with a good binocular, and found it not of uniform density, but having open spaces in it. It remained visible $8\frac{1}{2}$ minutes, and in that time apparently moved in a line towards the radiant point in *Leo*, over a space of 8°.

About half-a-dozen meteors were observed moving in directions towards the radiant. G.D.

Coast Survey Station, Santa Barbara, California.
Lat. 34° 24′ N., Long. 7^h 59^m.

Occultations of Stars by the Moon.

Observed at Maresfield, in Sussex, by Capt. W. Noble.

(Previously unreported.)

Monday, September 27, 1868.

Occultation of f Tauri.

The star disappeared (though not with extreme sharpness) at the Moon's bright limb at

$21^h\ 38^m\ 40^s{\cdot}5$ L.S.T. = $10^h\ 29^m\ 35^s{\cdot}5$ L.M.T.

Reappearance not seen.

Power 154 adjusted on the star.

Friday, February 19, 1869.

Occultation of 48 Tauri.

This star disappeared instantaneously at the Moon's dark limb at

$7^h\ 17^m\ 24{\cdot}3$ L.S.T. = $9^h\ 17^m\ 59^s{\cdot}5$ L.M.T.

and reappeared at the southern part of the bright limb about

$7^h\ 47^m\ 20{\cdot}15$ L.S.T. = $9^h\ 47^m\ 50^s{\cdot}8$ L.M.T.

Power 255 adjusted on the star.

Sunday, July 18, 1869.

Occultation of 49 Libræ.

The star disappeared about

$16^h\ 3^m\ 35^s$ L.S.T. = $8^h\ 16^m\ 53^s{\cdot}4$ L.M.T.

This was an unsatisfactory observation.

Power 255 adjusted on the star.

Wednesday, December 8, 1869.

Occultation of δ Capricorni.

The star disappeared instantaneously at the Moon's dark limb at

$22^h\ 45^m\ 34^s{\cdot}9$ L.S.T. = $5^h\ 35^m\ 23^s{\cdot}8$ L.M.T.

There was a great deal of haze.

Power 154 adjusted on the star.

I should state with reference to this observation, that, when I came to look at my slate by lamplight, after I had put down the instant of the star's disappearance, I found that I had, in some

unaccountable way, transposed the minutes and seconds. Had the *minutes* only been right, I should have taken the time of disappearance as 10 seconds later.

Tuesday, December 14, 1869.

Occultation of ξ^2 Ceti.

The star disappeared instantaneously at the Moon's dark limb at

$2^h\ 55^m\ 45^s{\cdot}3$ L.S.T. $= 9^h\ 21^m\ 26^s{\cdot}7$ L.M.T.

and reappeared at the bright limb, pretty sharply, at

$3^h\ 48^m\ 28^s{\cdot}6$ L.S.T. $= 10^h\ 14^m\ 1^s{\cdot}3$ L.M.T.

Power 255 adjusted on the star.

Having never yet made an independent determination of the geographical position of my Observatory, I have always employed data afforded by the Ordnance Survey, and assumed it to be situated in Latitude 51° 0′ 58″·3 North and Longitude $17^s{\cdot}5$ East. Our Fellow, Mr. F. C. Penrose, has now most kindly and obligingly computed my longitude from the above disappearance, and finds that, had such longitude depended upon this single observation, "it would have involved an error of only about 1300 yards." I hope, though, to refine upon this considerably.

Forest Lodge, Maresfield, Sussex,
14th January, 1870.

Observations of Jupiter's Satellites, and Occultation of Stars by the Moon. By John Joynson, Esq.

			G.M.T. h m s
15 Nov. 1869	1 Sat.	Ec. R.	7 52 32·0
	3	Tr. I. first	10 9 39
		last	10 38 52
		,, E. first	11 37 7
			11 56 23
22	1	Oc. D. first	7 14 15
		last	7 16 33
		Ec. R.	9 46 31·8
30	2	Ec. R.	5 11 45·0
	1	Tr. E. first	8 23 41
		last	8 28 20
		Sh. E.	8 56 55
			9 1 37
1 Dec.	1	Ec. R.	6 11 29·9

			G.M.T. h m s
3 Dec. 1869	3	Oc. R. first	7 54 10
		mid	7 56 15
		last	7 59 33
		Ec. D.	8 59 58·5
		R.	10 37 31·9
21	3	Tr. E. last cont.	4 58 32
23	2	Shad. full on	5 18 25
	1	Tr. I. first	6 4 7
		last	6 9 14
		E. first	8 9 24
		last	8 16 44
24	1	Ec. R.	6 28 5·5
31	1	Oc. D. first	5 3 47
		last	5 6 12
8 Jan.	2	Ec. R.	7 27 25·1
9	1	Ec. R.	4 49 38·2

Occultations of Stars by the Moon.

			G.M.T. h m s
10 Nov. 1869	30 Capricorni	Disappearance	7 0 30·6
17 ,,	μ Ceti	,,	9 48 19·7
		Reappearance	11 7 28·4

Waterloo, near Liverpool,
12th Jan. 1870.

On a Bright-Cross Micrometer for measuring the position of lines in faint Spectra. By John Browning, Esq.

Attempting recently to map out the spectrum of *Jupiter* I experienced great difficulty in determining the position of the lines. The spectrum was not sufficiently luminous to show the wire of the micrometer when it was opposite the red end of the spectrum, and it was in that portion that I wished to measure the position of the lines discovered by Mr. Huggins, which are probably due to the absorption of light in the planet's atmosphere.

As soon as I tried to light up the wire of the micrometer the spectrum became almost invisible, the lines being altogether lost.*

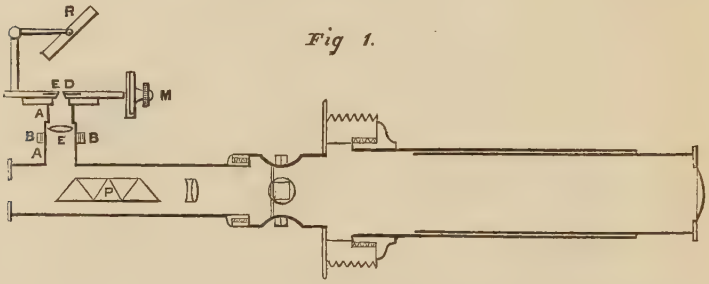
* Is the apparent brightness of *Jupiter* due entirely to the size of his disc? The spectrum of a star of the third magnitude is as brilliant even when widened by a cylindrical lens to the same breadth as *Jupiter's* spectrum.

Since writing the above, Mr. Proctor has kindly furnished me with an answer

To obviate this difficulty I contrived a bright-line micrometer, which is in action, and which I shall now have the honour to describe.

Fig. 1 represents the upper part of the star spectroscope. Attached to the side is a small tube, A A. At the outer part of this tube is a glass plate, blackened with two fine clear white

Fig 1.



lines across the centre, at an angle of 45°, like a letter X. These lines can, perhaps, be most neatly produced by photography.

The lens *c* which is focussed by turning the milled ring M, produces an image of the bright line in the field of view by reflection at the prism from the surface nearest the eye. On turning the micrometer screw, M, the slide which holds the glass-plate is made to travel in grooves, and the fine lines are made to traverse the whole length of the spectrum.

By means of the mirror, R, sunlight can be reflected into the micrometer. If desirable the light may be modified by placing a piece of silver paper spread with paraffin in front of the glass-plate.

Fig. 2 represents a spectrum, and shows the bright cross of

Fig. 2.

the micrometer in measuring a fine line in the most refrangible portion, where a wire or web would be imperceptible.

to this question, I had overlooked the obvious fact that while we have a star in the spectroscope, we obtain the whole light of the disc of the star, between the jaws of the slit, while, in the case of *Jupiter*, we have only the light of that portion of the disc of the planet to deal with which falls within the jaws of the slit. I would, therefore, propose to use the cylindrical lens, such as are used with the star spectroscope, in broadening the stellar spectra, but with the convexity of the lens turned in the other direction, that is to say, in the direction of the line of the slit instead of at right angles to it.

A Method of Constructing Charts by which in a few moments the Great Circle Course between any Two Points on the Globe may be accurately Obtained. By Richard A. Proctor, B.A.

It seems to me almost certain that the plan I am about to describe must have been thought of often before because it is so obvious. But as I have never seen any reference to it in works or papers where such reference was to have been looked for, I venture to bring it before the notice of the Society as having apparently a useful bearing on the problem of great circle-sailing.

It is well known that by Mr. Towson's tables the great circle course from one place to another may be calculated with considerable ease; but a construction by which such a course might be laid down on a chart is, as far as I know, still wanting. I remember having seen a paper (I believe by the Astronomer Royal) in which the difficult problem of laying down great circle courses on Mercator's charts was attacked. Later a short note appeared in which Sir John Lubbock showed how a construction founded on the principles of the gnomonic projection might be applied to the problem. I cannot at present recall where I read those papers, but I have an impression it was in the *Monthly Notices* or else in the *Memoirs* of this Society.

The fact that in the gnomonic projection the great circle course between two points is obtained by simply drawing a line through those points, is inviting. But as one cannot include in a chart even a complete hemisphere on the gnomonic projection, there is an obvious difficulty, which, as far as the purposes in question are concerned, renders the projection almost useless. And, in passing, I may note that so far as I am aware, no one has hitherto pointed out how the course between two points, one in the northern and one in the southern hemisphere, can be deduced (in great part) from gnomonic projections of the greater part of these hemispheres. The solution of the problem is exceedingly simple:—In the Northern map one must draw a straight line through the Northern station and *the antipodes* of the Southern; and the like with the Southern map. These two lines are the projection of the great circle through the points, so far as it falls within the maps. There can be no difficulty in selecting the segments which belong to the great circle course between the points.

The plan I have now to deal with has reference to the stereographic projection. In this projection every circle on the sphere appears as a circle. Every great circle is distinguished by the property that its points of intersection with the great circle around the centre of projection lie on a diameter of that circle. This in effect gives the geometrical construction for laying down a great circle through any two points on the projection. But

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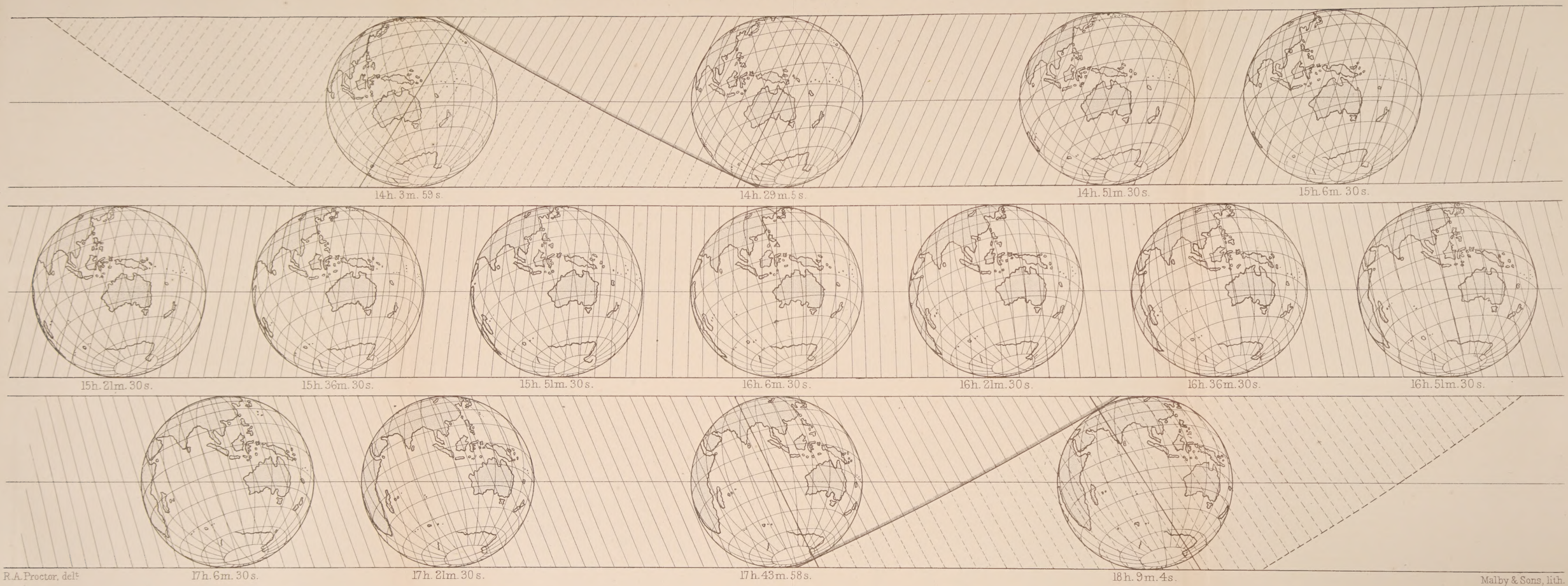
PASSAGE OF THE EARTH THROUGH VENUS'S SHADOW-CONE, DEC. 8, 1874.



R.A. Proctor, del.

Malby & Sons, lith.

The cross-lines radiate from the centre of the circular section of the Shadow-cone, so that, for places on the same line, the relative parallactic displacement of Venus is along a radius of the Sun's disc.